

**U.S. DEPARTMENT OF COMMERCE
National Technical Information Service**

PB-258 715-T

**Experimental Studies of Diffusion in the
Atmosphere of Cold Ventilation Emissions
from Viscose Fiber Plants**

Environmental Protection Agency, Research Triangle Park, N C

1971

300030

EPA-TR.647B-73
APTIC 48306

MAIN ADMINISTRATION OF THE HYDROMETEOROLOGICAL SERVICE

USSR COUNCIL OF MINISTERS

PB 258 715-T

ORDER OF THE RED BANNER OF LABOR

MAIN GEOPHYSICAL OBSERVATORY imeni A. I. Boyeykov

WORKS

Issue 254

ATMOSPHERIC DIFFUSION

AND AIR POLLUTION : 57-71.

Edited by

Doctor of Physical-Mathematical Sciences

M. Ye. Berlyand

Hydrometeorological Press

Leningrad 1971

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

ORIG
EPA-TR-647-73B

EXPERIMENTAL STUDIES OF DIFFUSION IN THE ATMOSPHERE
OF COLD VENTILATION EMISSIONS FROM VISCOSE FIBER PLANTS

(Eksperimental'nye issledovaniya rasseivaniya v atmosfere
kholodnykh ventilyatsionnykh vybrosov predpriyatiy viskoznogo volokna)

B. I. Vdovin, I. M. Zrazhevskiy, T. A. Kuz'mina, R. I. Onikul,
A. A. Pavlenko, G. A. Panfilova, G. P. Rastorguyeva, B. V. Rikhter

Atmospheric diffusion and air pollution
1971, pp. 57-71

Translated for EPA by
SCITRAN (SCIENTIFIC TRANSLATION SERVICE)
SANTA BARBARA, CALIFORNIA

EXPERIMENTAL STUDIES OF DIFFUSION IN THE ATMOSPHERE
OF COLD VENTILATION EMISSIONS FROM VISCOSE FIBER PLANTS

B. I. Vdovin, I. M. Zrazhevskiy, T. A. Kuz'mina, R. I. Onikul,
A. A. Pavlenko, G. A. Panfilova, G. P. Rastorguyeva, B. V. Rikhter

Regularities in the atmospheric distribution of emissions from plants with cold and low emissions have until recently remained little studied. The standardizing documents used in the Soviet Union to calculate the diffusion of pollutants contain a number of limitations regarding their application for chemical and other plants.

In 1966-1968, the Main Geophysical Observatory imeni A. I. Voyeykov (GGO) [Glavnaya geofizicheskaya observatoriya], under the direction of M. Ye. Berlyand, conducted four comprehensive expeditions to study the atmospheric diffusion of carbon disulfide and hydrogen sulfide from viscose fiber plants in Cherkassy, Krasnoyarsk and Balakovo (two expeditions). Taking part in the studies were: the State Design Institute of Artificial Fiber Plants (Giproiv), the Moscow Scientific Research Institute of Hygiene imeni F. F. Erisman, the Odessa Hydrometeorological Institute, as well as local hydrometeorological stations. A great deal of help was given by workers in inspection agencies, particularly the central laboratories and ventilation divisions.

The main purpose of the expeditions was to obtain experimental material for developing and extending a method of calculating diffusion in the atmosphere of cold ventilation emissions. Two ingredients--carbon disulfide CS_2 and hydrogen sulfide H_2S --were investigated.

At the factories and near them were emission sources of sulfur dioxide (for example, heat and power plants). Its concentration in the air was not measured and was first removed from samples.

The largest part of emissions of carbon disulfide and hydrogen sulfide was directed to 2-3 120-meter high ventilation pipes. A significant amount of these substances was also emitted into the air through ventilating shafts, fans and deflectors in production rooms and discharged through sewers to special tanks, located at some distance from the plants.

As the temperature in the shops and under the covers of technological equipment actually varied in narrow limits between 20-40°, in the summertime during the day, emissions differed little in temperature from the surrounding air and, in the established terminology, are called cold emissions.

The expeditions were conducted in Cherkassy from July 20 to September 5, 1966, in Krasnoyarsk from February 27 to March 31, 1967, and in Balakovo from July 23 to September 3, 1967, and from August 13 to September 9, 1968.

The factory in Cherkassy was located on the outskirts of town where buildings were principally 1-2 stories high. An area was found for meteorological and aerological observations with approximately the same conditions. The territory in a 10-15 km radius around the factory was relatively flat, its main characteristic being the large Kremenchug reservoir on the Dnepr, adjacent to the town, which has an area of over 2000 km².

In Krasnoyarsk the source was located amid residential areas where 2-3 story buildings predominated in the valley of the Yenisey River, which is quite wide within the city. The area in a 5-8 km radius around the factory, where samples were taken, had a rather flat underlying surface. The volume of meteorological observations near the factory was comparatively small. The main meteorological and aerological observations were conducted at the Yemel'yan weather station, located 30 km from Krasnoyarsk in a level part of the Yenisey River valley with small hills. In characterizing the underlying surface, we must also note that, because of the unusually early arrival of spring, the snow cover disappeared between March 10-17.

The Balakovo artificial fiber complex was located a short distance from the town.

The meteorological and aerological observation area was on an open, slightly hilly plain.

The sampling and analysis procedure

The distribution of a pollutant in the ground layer of air was characterized by single concentrations.

In all expeditions, samples were taken during daylight hours at a height of approximately 1.5 m, primarily under the factory plume. Sampling was conducted 5-7 hours every day, samples taken approximately once an hour. The sampling period lasted 20-30 minutes. To study a wider range of meteorological conditions, including ground and high temperature inversions, a sliding sampling schedule was used. According to this schedule, in all the expeditions except Krasnoyarsk, on the first and fourth days of the week, sampling was conducted between 2 and 9 p.m., on the second and fifth days from 9 a.m. to 4 p.m., and on the third and sixth days from 6 a.m. to 1 p.m. This schedule more completely revealed the effect of peculiarities in the daily variation of meteorological factors on the diffusion of pollutants. In the Krasnoyarsk expedition, sampling was conducted six times a week from 9 a.m. to 4 p.m.

Gases discharged from high stacks were invisible during the summer expeditions. In Krasnoyarsk, because of the condensation of water vapor in ventilation gases at low air temperatures, the plume was traced from the mouths of the stacks to distances of several hundred meters.

Emissions from hundreds of deflectors, shafts and other small sources distributed throughout the area were difficult to measure; rapidly changing in time depending on numerous factors, they are practically incalculable. Air pollution around these sources was not the main concern.

Therefore, a relatively small volume of samples were taken approximately 0.5-1 km from the center of the group of high ventilation chimneys on the leeward side. Basic observations began at a distance of 2 km where, as calculations in [2] show, a relatively homogeneous gas plume was formed with maximum concentration on the axis directed downwind and passing through the center of the plant. The axis of an invisible plume was tentatively determined by taking into account the direction of the wind and that of a heat and power plant by its characteristic odor.

Sampling stations were located at standard distances from the center of the factory (0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 and 15 km). Placement of

these points was determined from maps of the region, and in the absence of nearby pronounced reference points, by range finder and automobile speedometer readings.

In the Cherkassy and Balakovo expeditions of 1967, zones of 15 km were covered, in the Balakovo expedition of 1968--12 km, and in Krasnoyarsk--8 km.

At each distance along the axis of the plume part of the samples were taken with truck-mounted LK-1 electro-aspirators, providing simultaneously two samples of carbon disulfide and two of hydrogen sulfide. However, the use of electro-aspirators required heavy electric power supply sources (for example, storage batteries). To avoid using a large number of motor vehicles, which would be required with shifting winds, in Cherkassy and Balakovo in 1967 part of the carbon disulfide and hydrogen sulfide samples were taken with less ideal water aspiration tanks.

Simultaneous samples were taken at several points at each of 3-4 distances at Cherkassy and Balakovo. At Krasnoyarsk samples were taken only with electro-aspirators at two points at the same time at various distances.

Table 1

Number of carbon disulfide and hydrogen sulfide samples taken in expeditions at various distances from the center of the industrial site

Distance from center of industrial site (km)	Expeditions							
	Cherkassy		Krasnoyarsk		Balakovo			
					1967		1968	
	CS ₂	H ₂ S	CS ₂	H ₂ S	CS ₂	H ₂ S	CS ₂	H ₂ S
0.5	62	38	34	21	91	41	171	36
1	320	137	174	91	268	129	257	48
2	680	268	148	79	527	201	193	54
3	252	118	116	60	311	124	229	49
4	299	114	54	27	326	123	321	69
5	250	103	54	27	164	46	212	44
6	143	58	48	25	191	64	182	44
7-8	55	25	46	23	389	110	494	100
9-15	302	126	--	--	295	66	445	91
Total	2363	987	674	353	2562	904	2504	535

This was due to the more severe cold weather conditions.

A truck was usually located on the axis of the plume and posts with water tanks on both sides. The space between adjacent points at the same distance was not strictly fixed; it varied, depending on sampling conditions and other factors from about 50 to 400 m. In particular, at close distances this space was usually less than at far distances, where the field of concentration was the same across the plume.

In the first Balakovo expedition, the concentration of hydrogen sulfide on the periphery of the plume, as a rule, was within the limits of sensitivity of the measurement method; therefore, in the second expedition measurements were made only on the presumed axis of the plume according to one sample per distance at a given moment of time. Results of the study are given in Table 1.

Over 8000 samples of carbon disulfide were suitable for analysis and about 3000 samples of hydrogen sulfide.

In Krasnoyarsk, samples were also taken in an airplane and a helicopter directly in stack plumes. These results were detailed in [7].

In Balakovo in 1967, a stationary post was located 3 km northwest of the factory, where 200 samples each of carbon disulfide and hydrogen sulfide were taken. During a 5-day period air was sampled 100, 250 and 500 m from the lake (on the leeward side) which is 5 km from the factory and used as a settling tank for sewage. A total of about 250 samples were taken of carbon disulfide and 50 of hydrogen sulfide.

Samples were taken in a U-shaped absorber. They were analyzed the same day or the next. In all expeditions, the standard method of determining carbon disulfide in air was used, for which the maximum permissible concentration (MPC) is 0.03 mg/m^3 . This method is based on the absorption of carbon disulfide by an alcohol solution of diethylamine and determination of concentrations by the intensity of the yellowish-brown color of copper diethylcarbamate [10]. The sensitivity of the method is 0.03 mg/m^3 . The method is not specific in the presence of hydrogen sulfide. Therefore, in the first expedition in front of the absorber with diethylamine solution was placed the same kind of instrument with an absorbent solution for hydrogen sulfide. In the next effort to determine concentrations of carbon disulfide in the air, a more convenient and

reliable method of air sampling was developed [11]. It was suggested that special solid chemisorbent cartridges to remove hydrogen sulfide and sulfur dioxide be used.

In the first expedition to determine hydrogen sulfide (MPC is 0.008 mg/m^3) the standard method [10] was used, which is based on the absorption of hydrogen sulfide by an alkaline solution of sodium arsenite.

The resultant sulfur salt, reacting with an acid solution of silver nitrate, gives a yellowish-brown colloid solution of silver sulfide. The method is specific, but its sensitivity is rather low -- 0.012 mg/m^3 . Therefore, in the following expeditions a more sensitive method was used, based on the absorption of hydrogen sulfide by a suspension of cadmium hydroxide and determination by methylene blue with para-amino dimethyl aniline [1]. Sensitivity of the method is 0.006 mg/m^3 . Sulfur dioxide in sampled air was removed with the use of special chemisorbent cartridges for sulfur dioxide.

To prevent strong evaporation of their solution during high external temperatures, the absorbers were enclosed in special cold water baths.

Meteorological and aerological observations

In all expeditions detailed meteorological and aerological observations were made around the clock; during the sampling period the observations were greatly expanded and more frequent. Included in the program of meteorological observations in the ground layer were: measurement of the temperature and humidity of air and soil, wind speed and direction, precipitation and pressure, visual observations of cloudiness and special weather phenomena.

Gradient observations were made on telescopic masts of wind speed, temperature and humidity in the layer up to 17 m (at Krasnoyarsk to 8 m). These observations made it possible to calculate coefficients of turbulent diffusion and turbulent flows of the pollutant, heat and moisture. As an example, Fig. 1 gives average data on the daily variation of the coefficient of turbulent diffusion for all expeditions.

In summer expeditions, observations were made of the humidity of the soil and its temperature on the surface and at depths to 20 cm. Evaporation from the surface of the soil was also measured with an evaporimeter. For closed heat balance of the underlying surface, actinometric observations were also

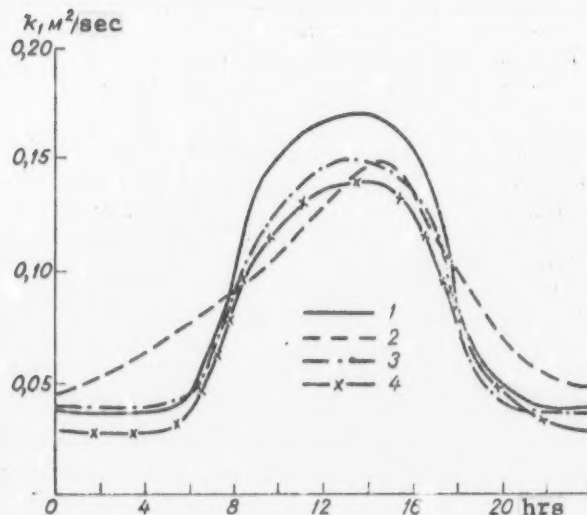


Fig. 1. Average daily variation in the coefficient of turbulent diffusion at an altitude of 1 m for the period of the expedition, calculated according to gradient observations:

1--Cherkassy, 2--Krasnoyarsk, 3--Balakovo 1967,
4--Balakova 1968.

made of components of the radiation balance (direct, diffuse and reflected solar radiation, as well as effective radiation of the underlying surface). Heat balance observations were made to obtain independent supplementary information about the coefficient of vertical turbulent diffusion.

In all expeditions, changes in wind direction were recorded with M-12 and M-45 anemorhumbographs. On the basis of these data, wind direction variance was studied, which is an important characteristics of atmospheric diffusion across the plume.

Regular aerological observations included measuring the temperature and humidity in the ground layer of air to altitudes of 1-1.5 km using YaK-12 light airplanes, MI-1 helicopters and radiosondes. For radiosonde observations A-58, A-22-IV and A-22-VII radiosondes were used, which are released slowly [5, 6, 8].

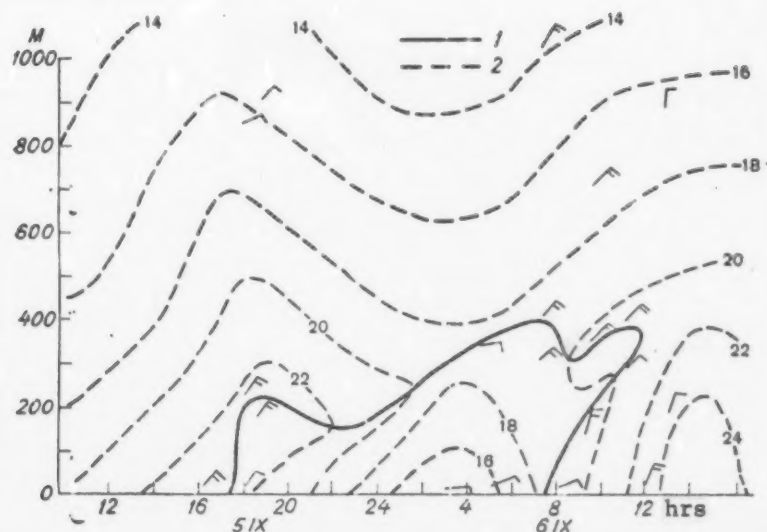


Fig. 2. Time cross section of lower kilometer layer of the atmosphere for the Balakovo station, September 5-6, 1968.

1--boundary of inversion; 2--isotherms

The speed and direction of the wind at various altitudes in the ground layer of the air were determined from single point and reference observations of pilot-balloons and radiosondes. The use of reference pilot-balloon observations has also helped ascertain several parameters characterizing turbulence in the ground layer [3].

To calculate the vertical component of the coefficient of turbulent diffusion, the airplane program included recording overloads and temperature fluctuations. At Krasnoyarsk, to determine parameters of turbulent diffusion a study was also made with airplanes and helicopters to study the visible configuration of plumes discharged from high ventilation stacks and their concentrations were determined.

More detailed information on this complex of aerological observations is given in [5] and [6].

On the basis of aerological data for all expeditions, time cross sections of the ground layer of air were constructed, graphically representing the evolution of inversions, layers of elevated instability, wind regime, etc.,

as well as more accurately determining the aerological structure between observations (Fig. 2).

The illustration gives isotherms and inversion boundaries. At corresponding altitudes, wind directions and speeds are also shown. One long "feather" corresponds to a wind speed of 2 m/sec., a short one to 1 m/sec.

Characteristics of weather conditions

The number of samples of carbon disulfide and hydrogen sulfide taken at different times was not the same. However, calculations have shown that the specific number of samples of ingredients taken in different weather conditions

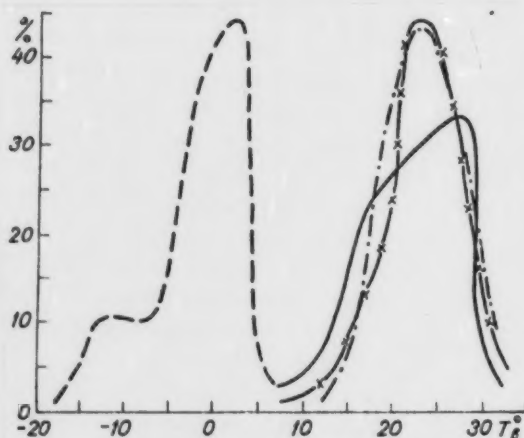


Fig. 3. Number of samples (average percent for carbon disulfide and hydrogen sulfide) taken in various air temperatures T_B^0 at an altitude of 1 m.

For legend see Fig. 1.

was approximately the same; therefore, Table 1 and Figs. 3 and 4 give their average values. These illustrations are quite clear and need no detailed commentaries. We note that the greatest number of samples pertains to convective weather conditions with air temperatures of 15-30° and wind speeds of 1-6 m/sec.

The unusually early arrival of spring in Krasnoyarsk provided comparatively complete data in this expedition at temperatures above -10, -15°,

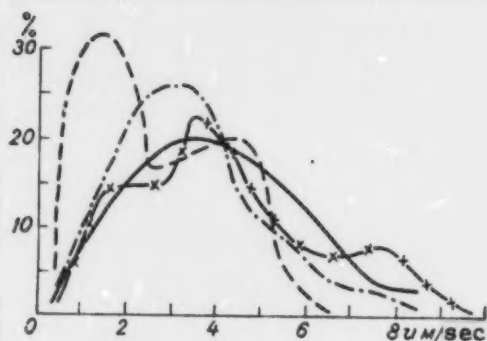


Fig. 4. Number of samples (average percent for carbon disulfide and hydrogen sulfide) taken at various wind speeds u at wind vane height.

For legend see Fig. 1.

primarily from -5 to $+5^\circ$. The wind was slightly weaker than in the summer.

On the basis of using a sliding sampling schedule, accompanied by more frequent meteorological and aerological observations, it was possible to obtain extensive factual information on air pollution in all basic types of atmospheric stratification: unstable stratification, stable conditions, high alti-

Table 2

Number of samples (in %) in various types of temperature stratification in the 0-500 m layer

Station	Stratification			
	unstable	stable	high inversion	ground inversion
Cherkassy	67	--	21	12
Krasnoyarsk	30	40	19	11
Balakovo				
1967	51	11	22	16
1968	54	8	20	18

tude ground inversions of temperature. As was to be expected, the most samples in summer expeditions pertained to unstable stratification, although in the winter-spring conditions at Krasnoyarsk these conditions were also often noted. Near-stable conditions played an important role only in Krasnoyarsk. The frequency of ground and high temperature inversions was not very different in all expeditions.

Evaluation of emission parameters

The study of emission parameters, necessary for the calculation of the distribution of concentrations in the atmosphere, was of great importance. These works proceeded in several directions, including a study of literature data, generalization of operational experience of similar plants and direct investigation of factories during the expeditions. These studies were conducted by Giprov workers V. B. Menis and G. L. Shmerling.

Air pollution by harmful emissions from viscose fiber plants is due to losses of carbon disulfide used in one of the initial stages of production to treat alkaline cellulose. Cellulose xanthate is formed, which in solution with alkali is also called "viscose." The amount of carbon disulfide used in producing cellulose xanthate is strictly calculated. Total emission of carbon disulfide into the air cannot exceed this expenditure. This was used in the critical evaluation of the total discharge of carbon disulfide, based on direct measurements of concentrations in stacks, ventilators, etc; it also helped to formulate a scientifically-based balance of carbon disulfide and hydrogen sulfide.

Let us dwell briefly on a description of emissions of these ingredients at various stages in the technological process of these factories [12],[13].

In the formation of cellulose xanthate, several percent of the total amount of carbon disulfide is lost through low ventilation shafts connected to local ventilation of chemical shops.

A large amount of thiocarbonates is formed in viscose undergoing special prolonged treatment in tanks. During reactions occurring during the spinning of viscose, hydrogen sulfide develops from the thiocarbonates. Carbon disulfide and hydrogen sulfide are also released in very high amounts in spinning plants

and in part in finishing plants under machine covers. Considerable discharges of these ingredients also occur in acid plants in reclaiming solutions in settling and finishing tanks. 67

Plants have given a great deal of attention to sealing machines and installing local ventilation pumps attached to a gas scrubber or to high stacks in all parts of the technological equipment with the highest emissions of carbon disulfide and hydrogen sulfide.

Centralization of the most gas-laden air in high stacks is advantageous for two reasons. First of all, the natural diffusion properties of the atmosphere are used to a maximum degree. Secondly, optimum prerequisites are created for effective operation of complex and expensive gas scrubbing equipment, which primarily requires large initial concentrations of carbon disulfide and hydrogen sulfide.

Low-gas ventilation emissions are also connected as much as possible to high chimney stacks after gas scrubbing. Here the total emission value changes very slightly, and at the same time, because of the increased exit velocity into the air, the rise of the plume increases and concentrations in ground air decrease. From this point of view, it is especially effective to connect low-gas but high-volume emissions of intense ventilation to high stacks after gas scrubbing when they come from work sites where spinning and finishing machines are uncovered.

Despite all measures undertaken in fiber spinning factories in finishing, reclaiming settling tanks and other operations, a certain amount of carbon disulfide and hydrogen sulfide are discharged into the atmosphere through low sources located around the roofs of buildings.

At various stages in the technological process, significant amounts of carbon disulfide and hydrogen sulfide are removed in sewage, from which they enter settling equipment located at some distance from the factory. A certain part of these substances combines in nonvolatile compounds in the settling tanks and the rest enters the atmosphere.

To establish the balance of carbon disulfide and hydrogen sulfide, V. B. Minis and G. L. Shmerling completed important work in the generalization of existing material on losses of carbon disulfide and hydrogen sulfide at

various stages in the production of viscose fiber. They found that accumulated data have a wide range and are characterized by known contradictions. Nevertheless, a sufficiently typical specific balance could be formulated.

The balance indicates that approximately 60% of expended carbon disulfide is discharged in such a way as to be directed to gas scrubbers or high stacks. About 10% of carbon disulfide is removed with industrial drainage in sewers. The proportion of low emissions of carbon disulfide in the atmosphere largely depends on the sealing of spinning and finishing machines, the connection of local acid plant pumps to high stacks, etc. On the average, it can be assumed that low emissions of carbon disulfide are 12-15% of the total amount of carbon disulfide consumed in the production of viscose xanthate. Approximately 15% of carbon disulfide changes to hydrogen sulfide in the aging process of viscose. Two molecules of hydrogen sulfide are formed from one molecule of carbon disulfide. Taking into account the molecular weights of carbon disulfide and hydrogen sulfide (76 and 34), we find that approximately 0.9 g of hydrogen sulfide is obtained from 1 g of carbon disulfide. The ratio of low and high emissions of hydrogen sulfide also depends on measures to seal machines and other technological factors. This balance shows that in the most complete set of measures to reduce low emissions of hydrogen sulfide they constitute approximately 4-5% of the total amount of hydrogen sulfide. If local ventilation of acid plants is not connected to high stacks, then the proportion of low emissions of hydrogen sulfide can reach 18-20%. The percentage of hydrogen sulfide emissions in sewage is approximately the same as for carbon disulfide.

In all expeditions the volume of discharged air was determined in high stacks as well as the concentration of carbon disulfide and hydrogen sulfide. On the basis of the measurements, total emissions of these ingredients were calculated. However, if volumes of air changed little during one expedition and were determined with sufficient accuracy by the output of operational ventilation plants, then measuring concentrations of discharged gases in a stack, combining a large number of gas flues with sharply differing gas levels, was a very complicated problem.

In Cherkassy, concentrations of carbon disulfide and hydrogen sulfide were determined in stacks first and primarily for methodological purposes. Results of these works essentially contradict the formulated specific balance. In later expeditions, it was possible to reach satisfactory agreement between emissions in high stacks according to direct measurement data and the specific balance of carbon disulfide and hydrogen sulfide.

Gas scrubbing was used only in Balakovo. In 1967 one of the factories here used carbon disulfide purification, with little effectiveness and not every day. In 1968, there was no carbon disulfide purification. At the same time, hydrogen sulfide purification operated quite stably during both expeditions with an efficiency ratio averaging 80-85%; at the same time it recovered 15-20% of the carbon disulfide. The average efficiency ratio of gas scrubbing was determined on the basis of measurements of the concentrations of harmful substances in gas flues before and after scrubbing. This characteristic of the effectiveness of gas scrubbing equipment (efficiency) is more suitable than the index sometimes used with this means of purification--the residual concentration of harmful ingredients after gas scrubbing.

Fig. 5 gives the M_e/M_b ratio for both ingredients for Krasnoyarsk and Balakovo, where M_e is the experimentally measured amount of harmful emissions in the atmosphere on a given day and M_b is the amount of emissions calculated according to the specific balance of carbon disulfide and hydrogen sulfide, taking into account the average gas scrubbing efficiency ratio. The amount of emissions was taken as the total for all factories. The agreement between balance calculations and measurements must be considered satisfactory.

In these plants the height of stacks was 120 m; their diameter was 7 m.

The exit velocity of gas-laden air w_0 into the atmosphere was determined by the volume of emissions V_1 and the diameter of the mouth of the stacks D , according to the formula $w_0 = \frac{4V_1}{\pi D^2}$. In Cherkassy, w_0 was approximately 12 m/sec., in Krasnoyarsk 8 m/sec., and in Balakovo, 6 m/sec.

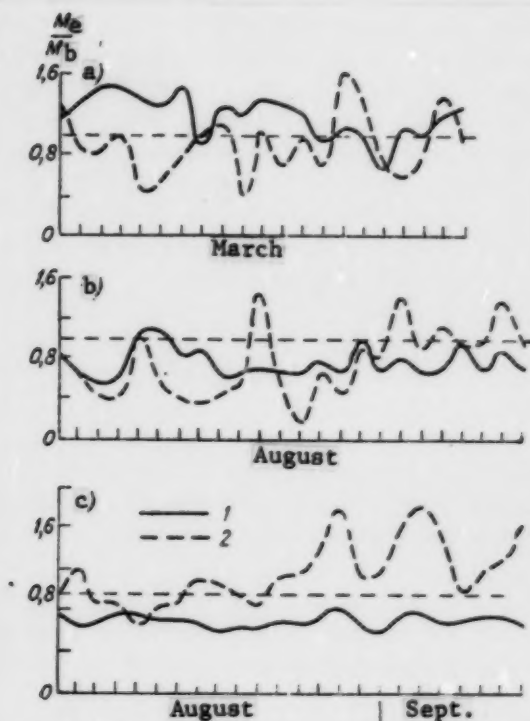


Fig. 5. Comparison of total emissions of carbon disulfide (1) and hydrogen sulfide (2) in stacks, calculated according to specific balance and the concentrations of these ingredients in gas flues.

a -- Krasnoyarsk, 1967, b -- Balakovo, 1967,
c -- Balakovo, 1968.

At Balakovo in one of the factories, for technical reasons, emissions were made at a height of 50 m through an opening 10 m in diameter at the rate of 3 m/sec.

Upon entering the atmosphere, the emissions had a temperature close to that in the plants (20-40°). Therefore, in the entire cold, and a large part of the warm season, especially at night, excess emission heat ΔT was 40-50° or more in winter. However, in the summer excess heat ΔT was low, and during the day sometimes close to zero.

Fig. 6 gives the average difference between the temperature of emissions

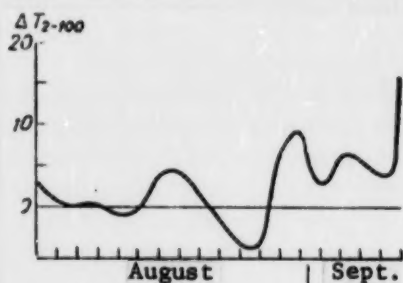


Fig. 6. Average excess heat of emissions from stacks in relation to the air at the mouth of the stack

from one factory and that of the air at the level of the mouth of the stack during the sampling period, i.e. during daylight hours, for Balakovo (1968).

At each factory a large number of low emission sources were scattered around the roofs of shops. These are ventilation shafts, various kinds of ventilators, deflectors, etc. A certain amount of emissions also came from windows and doors. Low emissions were a significant part of the total.

Comprehensive studies of emissions from low sources were made only in 1968 in Balakovo. Here during the period of the expedition, 3 measurements were made of emissions from 288 sources, as well as the exit velocity of ventilation gases and their temperature. Significant emissions from exhaust fans of spinning shops, acid stations, etc. were observed. The total amount of low emissions of carbon disulfide and hydrogen sulfide satisfactorily agrees with that calculated according to the specific balance. The considerable differences between emissions from similar factories and the small amount of carbon disulfide emissions from shops producing cellulose xanthate indicate the necessity of improving methods of similar studies and their continuation.

The range of parameters of low sources in Balakovo was: height of emissions $H_1 = 8 - 20$ m, diameter of the mouth $D_1 = 0.2 - 2.2$ m, temperature of emission $T_{r1} = 15 - 40^\circ$, exit velocity of ventilation gases $w_{01} = 3 - 20$ m/sec. The average values of these parameters, weighted by the combination of pollution sources in the air basin, are: $H_1 = 15$ m, $D_1 = 1$ m, $T_{r1} = 25^\circ$ and $w_{01} = 5$ m/sec.

In conclusion, let us note that despite substantial difficulties in organizing studies of artificial fiber plants, the results made it possible to calculate the field of concentrations of carbon disulfide and hydrogen sulfide

and investigate the dependence of air pollution on meteorological conditions [2], [4].

REFERENCES

1. Alekseyeva M. V. Opredeleeniye atmosferykh zagryazneniy (Determination of atmospheric pollution). Moscow, Medgiz, 1963.
2. Baykov B. K. et al. Experimental verification of a method of calculating the atmospheric diffusion of cold emissions in data from observations of artificial fiber plants. See this collection.
3. Berlyand M. Ye. Onikul R. I. Physical principles of calculating the diffusion in the atmosphere of industrial emissions. Tr. GGO (Works of the Main Geophysical Observatory), 1968, Issue 234, p. 3-27.
4. Berlyand M. Ye., Onikul R. I. Extension of the theory of diffusion of industrial emissions in the atmosphere. See this collection.
5. Vdovin B. I., Voloshin V. G. The frequency and accuracy of temperature sounding of the ground layer of air. Tr. GGO, 1969, Issue 238.
6. Voloshin V. G. The question of using radiosondes for studying the ground layer of the atmosphere. Tr. GGO, 1968, issue 234, p. 223-230.
7. Yeliseyev V. S. A study of the structure of a smoke stream and determination of the coefficient of turbulent mixing in vertical distribution of concentrations. Tr. GGO, Issue 234, p. 95-99.
8. Yefimov P. A. Experiences in sounding the lower three-kilometer layer of the atmosphere with a A-58 radiosonde. Tr. TsAO (Works of 1966, Issue 74).
9. Zaytsev A. S. A study of the characteristics of turbulence using pilot-balloons. Tr. GGO, 1969, Issue 238.
10. Instruktivno-metodicheskiye ukazaniya po organizatsii issledovaniya zagryazneniya atmosfernogo vozdukha (Methodological instructions for organizing air pollution studies). Moscow, Medgiz, 1963.
11. Pavlenko A. A., Kuz'mina T. A. A method of determining hydrogen sulfide and carbon disulfide. Tr. GGO, 1968, Issue 234, p. 188-195.
12. Rogovin Z. A. Osnovy khimii i tekhnologii proizvodstva khimicheskikh volokon [V 2-x t.]. Izd. 3-e. (Principles of chemistry and the technology of manufacturing chemical fibers [In 2 volumes] 3rd ed.) Moscow-Leningrad, "Khimiya", 1964.
13. Ryauzov A. N. Tekhnologiya khimicheskikh volokon (The technology of chemical fibers). Moscow, "Vysshaya shkola", 1964.